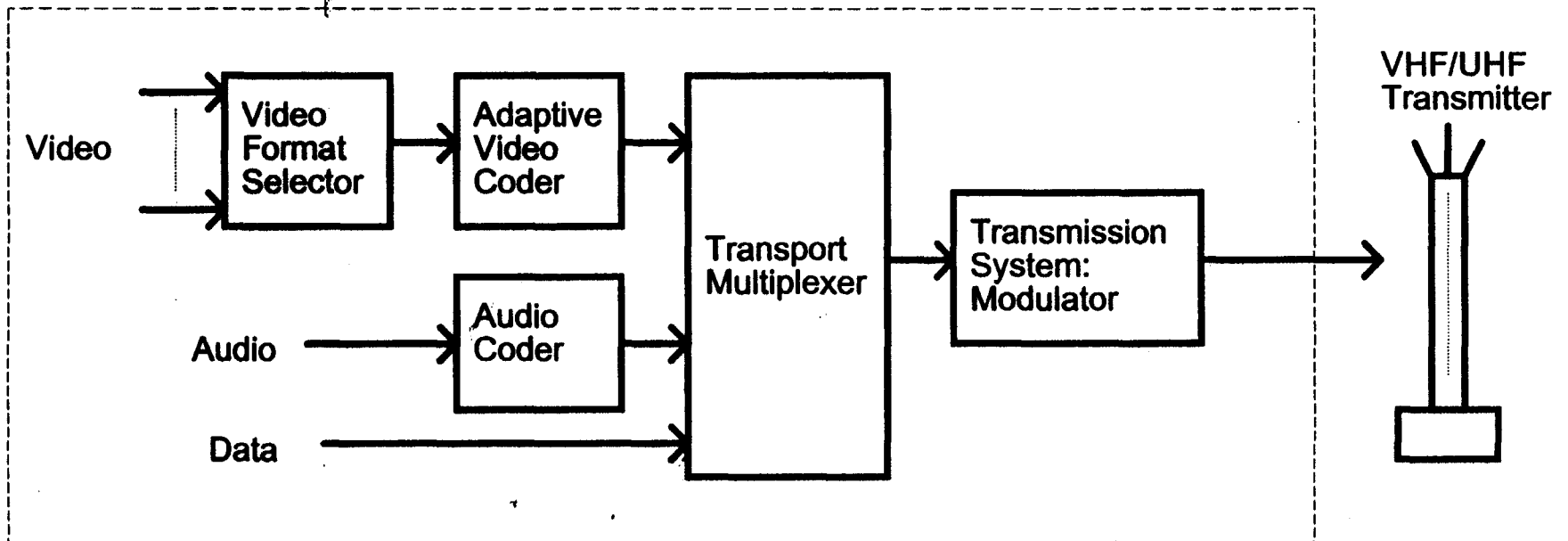
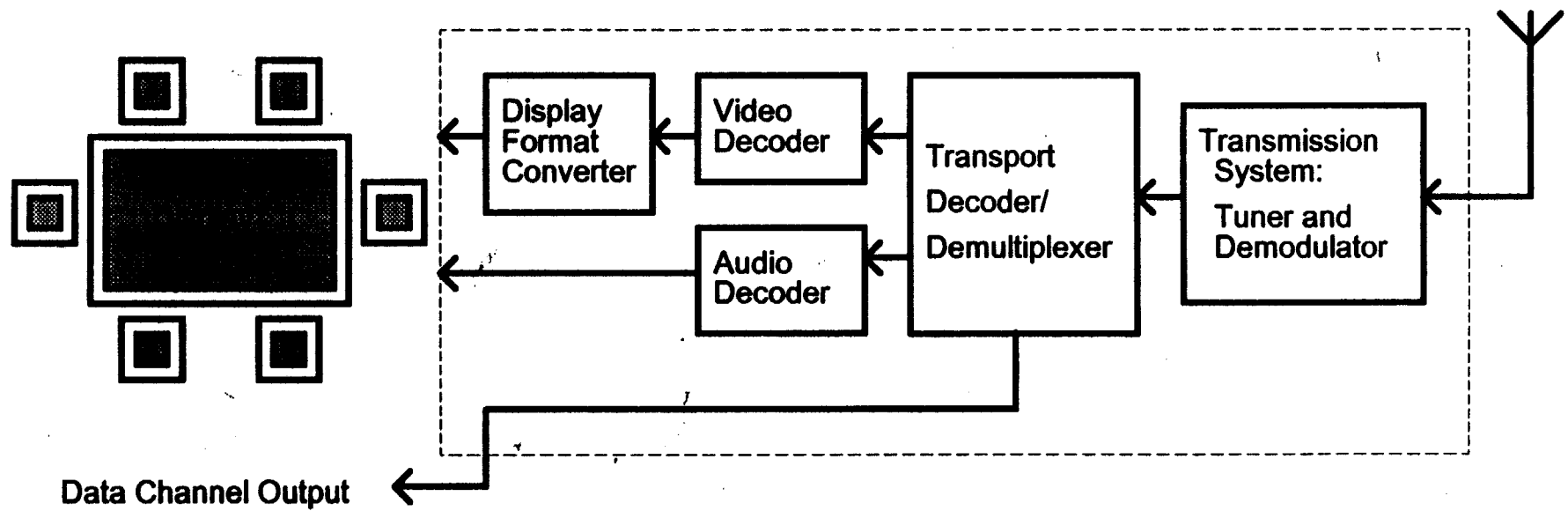


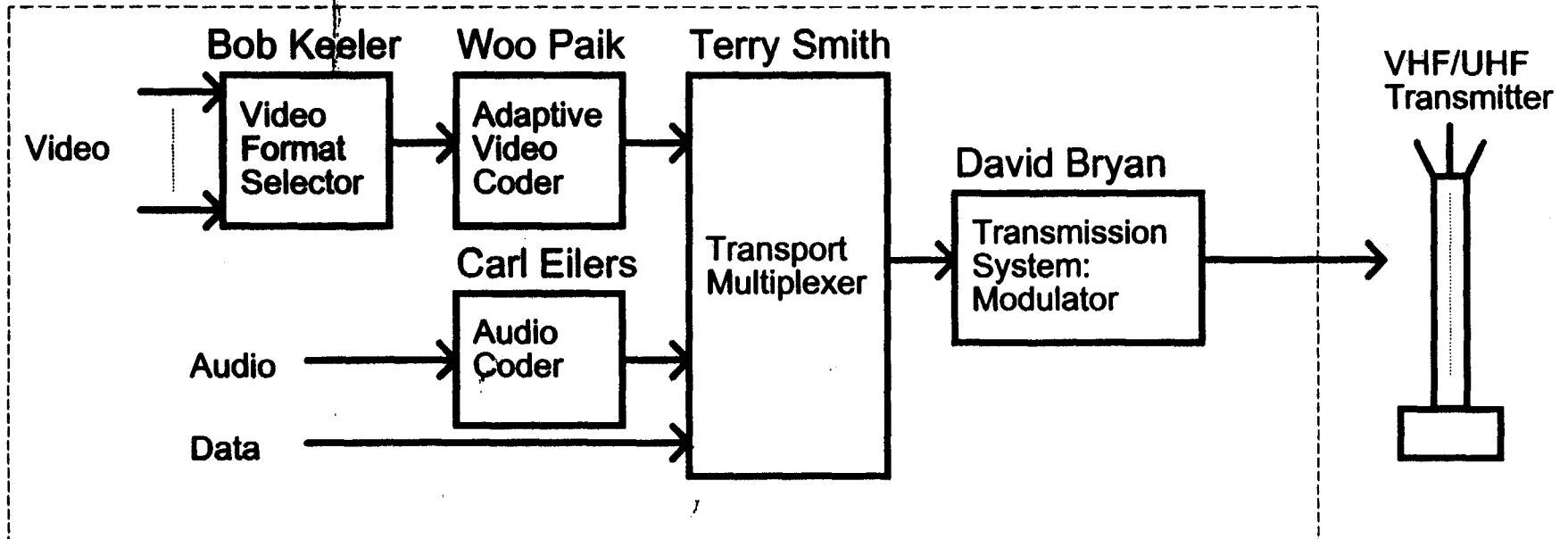
Transmitter



Receiver



Presenters



Development Plan: Carlo Basile

Summary: Wayne Luplow

Presenters

- **Video Format** : **Bob Keeler**
- **Video Compression** : **Woo Paik**
- **Audio Compression** : **Carl Eilers**
- **Transport** : **Terry Smith**
- **Transmission** : **David Bryan**
- **Development Plan** : **Carlo Basile**
- **Summary** : **Wayne Luplow**

FORMAT

June 30, 1993

AGENDA

- **Baseline formats**
- **Rationale for formats**
- **Open format issues**
- **Resolution of format issues**
- **Schedule for resolving format issues**

Baseline Transmission Format Specifications

- **Six formats supported for HDTV transmission**
- **Frame rates for live video as well as 24 Hz and 30 Hz for purposes such as film**
- **Both 720-line and 960-line formats supported**
- **Interlaced scan for 60 Hz 960-line format, with square pixels and lesser (horizontal) resolution non-square pixels**
- **Progressive scan transmission with square pixels for 720-line formats and 960-line film modes**
- **Migration to 60 Hz progressive scan with high line number as soon as feasible**

Format	Vertical Size	Horizontal Size	Frame/Field Rate	Scan Mode	Aspect Ratio	Square Pixels
A	720	1280	60 Hz	Progressive	16:9	Yes
B	720	1280	30 Hz	Progressive	16:9	Yes
C	720	1280	24 Hz	Progressive	16:9	Yes
D	960	1728 or 1408	60 fields/sec	Interlaced	16:9	Not for 1408 pels/line
E	960	1728	30 Hz	Progressive	16:9	Yes
F	960	1728	24 Hz	Progressive	16:9	Yes

Potential High Line Number Format

Extensibility

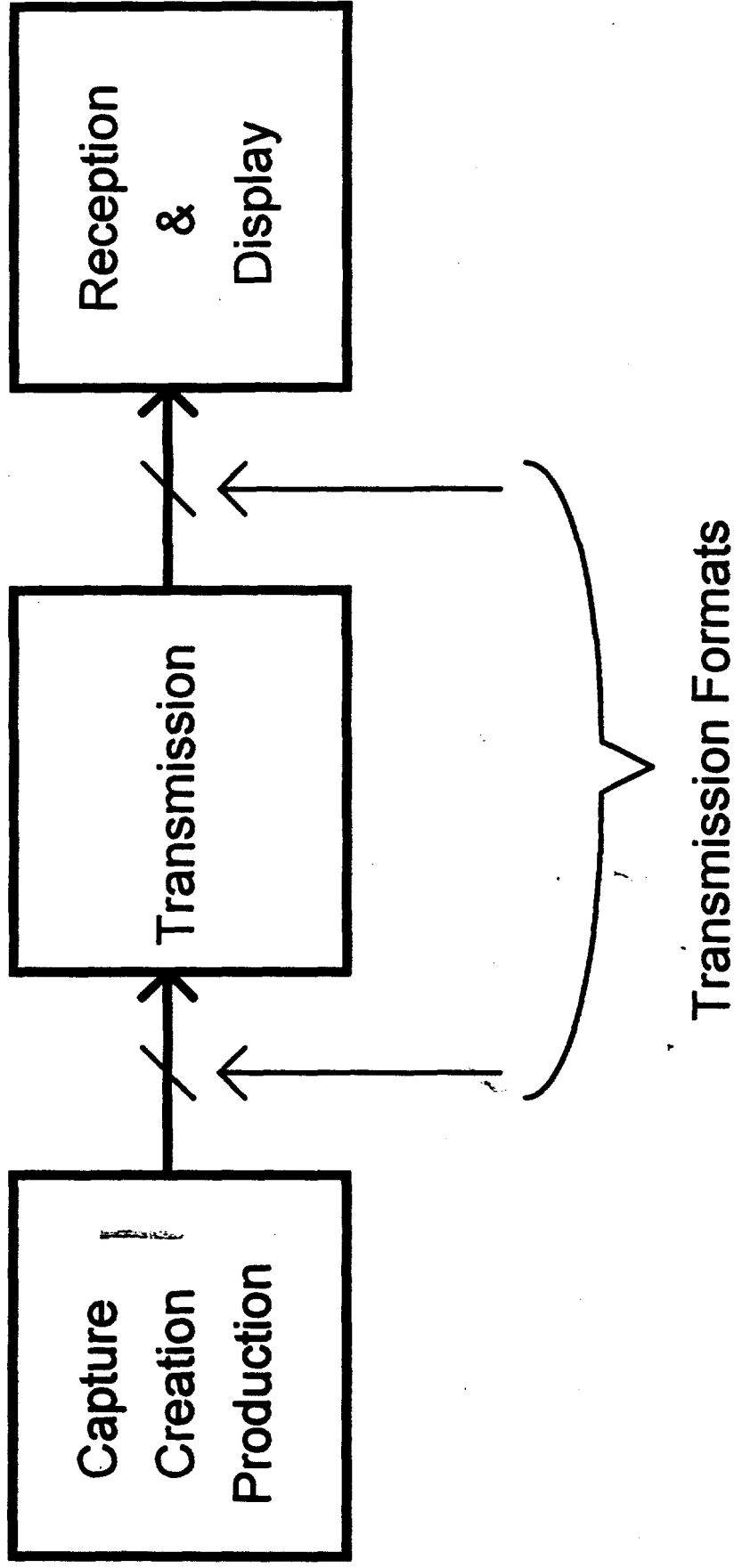
- **960-line progressive scan, 60 Hz (nominal) has appeal as natural extension of baseline formats**
- **Could be a logical choice for receiver implementation as native-mode display for high-end receivers, as manufacturer option**

60 Hz Nominal Frame Rate

- **60.0 Hz or 59.94 Hz**
- **Alliance acknowledges importance of both 59.94 Hz and 60.0 Hz frame rates**
- **Currently under investigation**
 - **Closure July 31, 1993**

Rationale

- **Formats support excellent quality images for wide range of source material**
- **Formats accommodate progressive scanning and square pixels that will be important for multimedia and computer applications**
- **Formats are consistent with the 6 MHz bandwidth constraint of the television broadcast channel**
- **Formats allow early implementation of HDTV standard**
- **Formats address near-term needs of broadcast industry, as well as current and anticipated telecommunications, multimedia and computer industry needs**



Alliance Formats Address Transmission Interface

Film Modes - 24 Hz and 30 Hz

- **Film capture is intrinsically representable in progressive scan formats, so film modes use progressive scan for transmission**
- **Film modes (24 Hz and 30 Hz) have pixel rates that are 40% and 50% respectively of the 60 Hz frame rate progressive scan image sequences**
- **Compression and transmission of film mode reduced-pel-rate formats leads to more efficient compression of film material, which will be an important source for HDTV**
- **Modes will be automatically identified within encoders and receivers**
- **Receivers re-format and display film modes at display frame rate, e.g. 60 Hz.**

Interlaced Scan - 960-line

- **Better resolution potential for still and low-motion images**
- **Intermediate step toward progressive high-line-number format**
- **Proven camera technology**
- **Proven receiver display technology**
- **Interlaced format has lower pixel rate**

Progressive Scan

720-line Formats and 960-line Film Modes

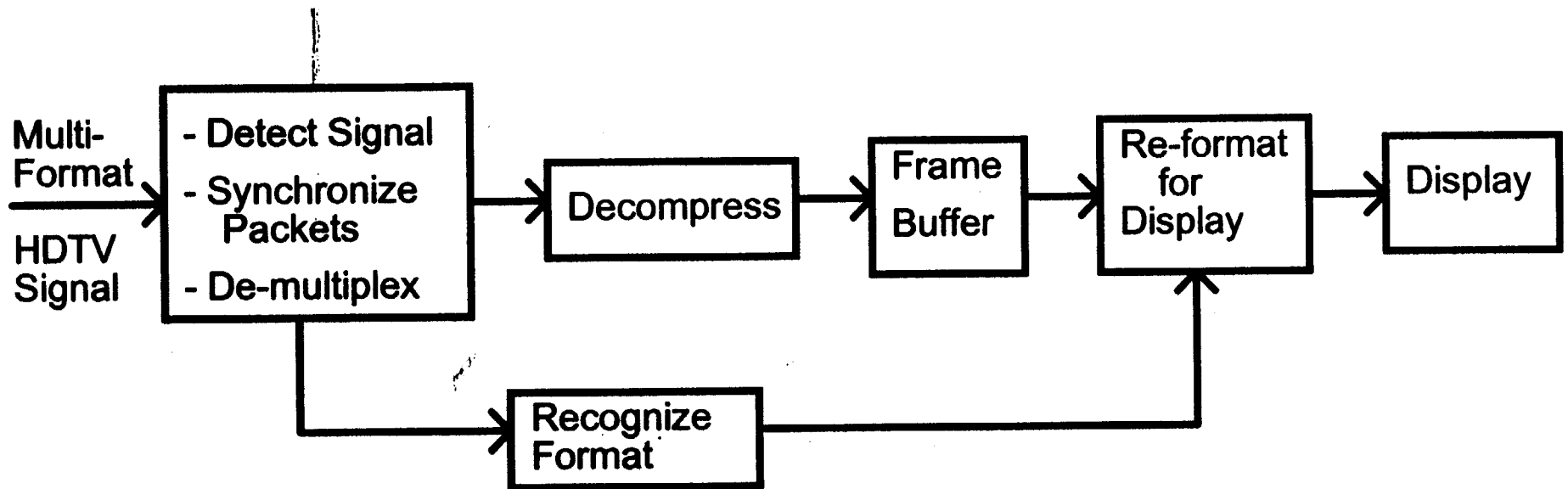
- **Superb 60 Hz motion rendition for action sequences using 720-line format**
- **Free of interline flicker**
- **Square pixels for 60 Hz, 24 Hz, 30 Hz frame rates**
- **Both spatial and temporal standards conversions are simplified by using progressive scan**
- **Allows simple coding algorithms**

Why Not 1080 Lines Instead of 960 Lines?

- Compression of 1080 by 1920 interlaced format is more demanding since pixel rates for 1080 by 1920 interlaced format range from 25% to 53% more than proposed 960-line interlaced formats
- 1080 by 1920 interlaced format requires more memory in receivers, than 960-line interlaced format
- Displays for 960 lines will be slightly less expensive than 1080-line displays
- Interoperability with NTSC is simplified

How Will Cost-effective Receiver Handle Six Formats?

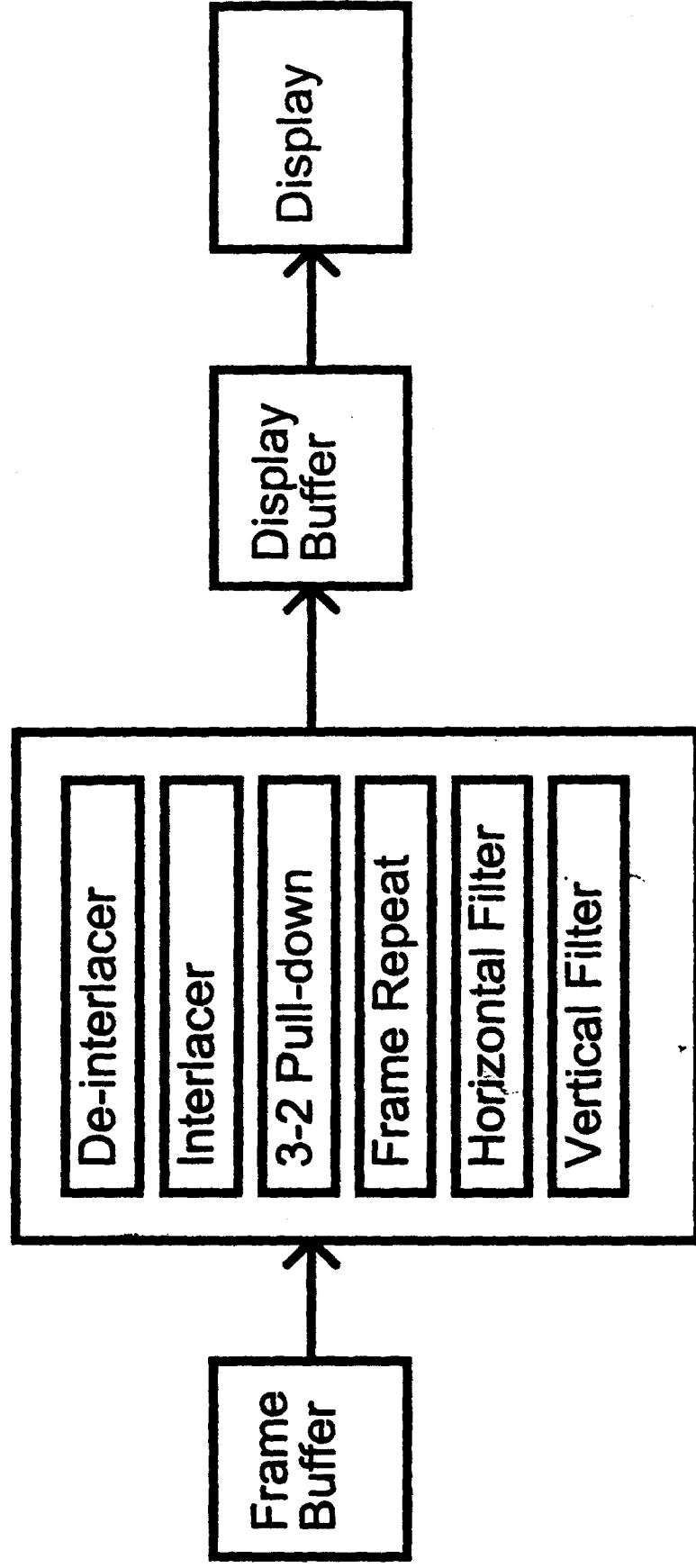
- **Receiver cost and complexity is basically driven by maximum memory size and speed which is a function of the most demanding format rate.**
- **Modular functionality in receivers**
 - **Detect, identify, recognize the format/mode**
 - **Decode and decompress image sequence**
 - **Deliver reconstructed images to receiver frame buffer**
 - **Re-format image in frame buffer for receiver's display**
- **Working assumption (receiver manufacturer implementation issue) is that entertainment receiver will have a single "native-mode" display format**
 - **Computer displays will be more likely to use multi-sync displays**



Multi-format HDTV Receiver

Multi-format Processing Burden on Receivers

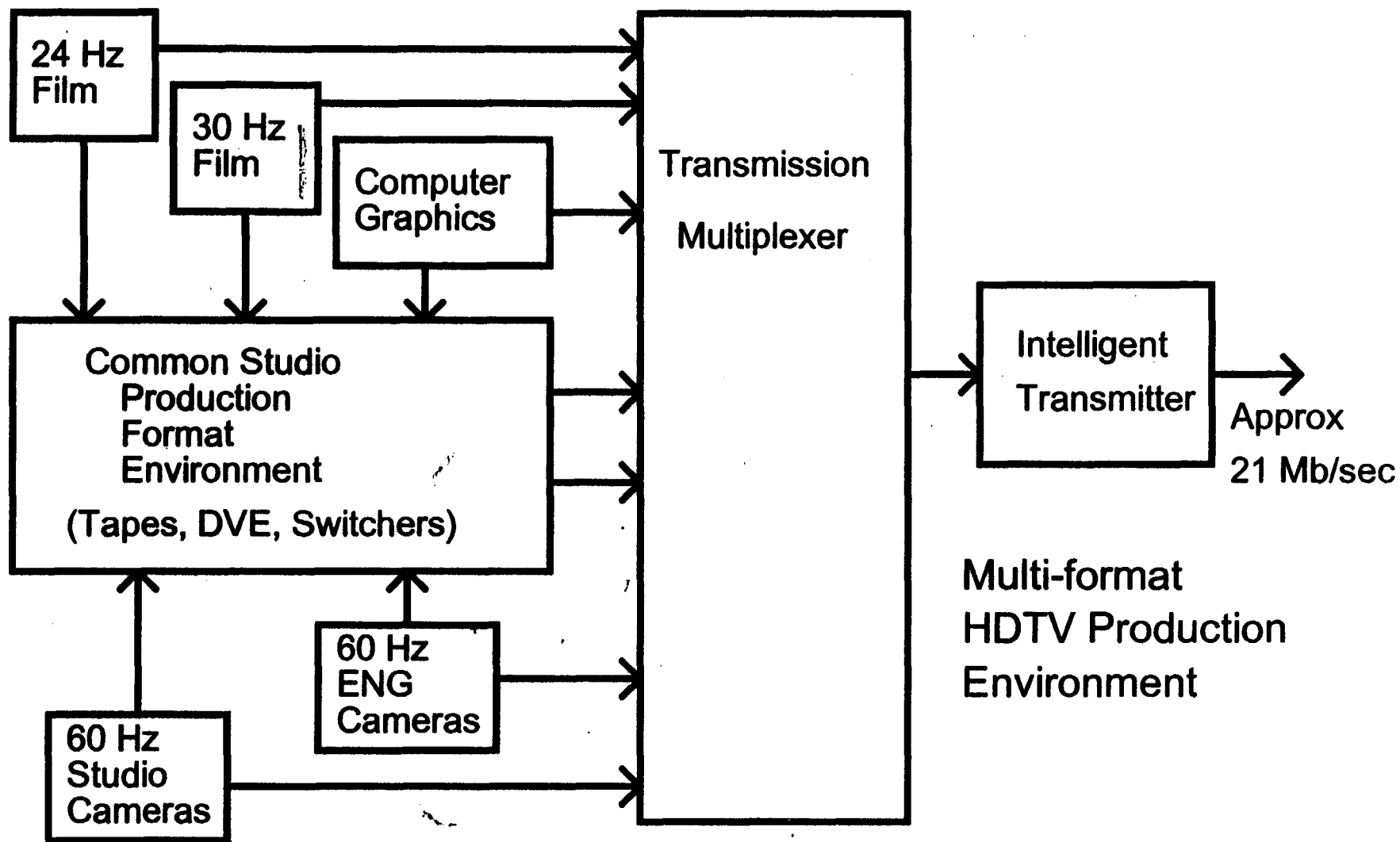
- **Receivers routinely synchronize and de-multiplex high-speed data streams, decode variable-length codewords, invert DCT coefficients, move blocks of image with arbitrary vectors, and store images in frame memory**
- **Incremental processing to re-format the image for a local receiver display format is not significant**
 - **Temporal repetition or 3-2 pull-down is simple**
 - **Spatial filtering is easy**
 - **De-interlacing not needed for progressive scan film modes**
 - **Simple de-interlacing adequate for smaller, low-end receivers**



HDTV Re-formatter for Display

Why Include Film Modes for 720-line Format?

- **Progressive scan does not introduce interlace artifacts**
- **Lower film-mode pixel rate means broadcaster can trade off artifact-free coding for spare channel capacity**
 - **Deliver pictures with fewer artifacts because of low pixel rate, or**
 - **Use fewer bits for coding with acceptable artifacts, and use portion of channel capacity for ancillary purposes**
- **720-line progressive scan has similar resolution to 960-line interlaced, depending on picture material**



Format Self-identification via Packet Headers

- **"Submerged complexity" made possible by digital, packetized representation and transport**
 - **Transmitter will send constant data rate, independent of format embedded in packetized transport**
- **Receivers will recognize self-identified format, and re-format as needed for native-mode display at nominal 60 Hz frame rate**

Format Open Issues

- **Migration path to higher line number with progressive scan**
- **59.94 Hz vs 60.0 Hz frame rate**
- **Total pixel counts on lines, and total line counts, to allow for guard space around active picture area**
- **Coordination with ATSC on formats for production, contribution, distribution and transmission**
- **Relationship to 525-line formats**

Schedule for Resolving Open Issues

- **Preliminary recommendations for 59.94/60.0 Hz issue by July 31**
- **Preliminary recommendations for horizontal pixel count guard space by July 31**
- **Goal is to establish final format specifications by September 15, 1993**